Scheme," a scheme which the conference recommended for adoption in the future, local patent offices are to be retained, each performing its present functions. There is also to be a fully organised central office for the detailed examination of applications for patents, the examination to include an extended search for novelty, the office eventually issuing the Empire Patents. But to make a patent operative in any country, registration in that country is compulsory, the registration being open to opposition if the local law provides for opposition to the granting of a patent.

By a "Provisional Scheme," which is recommended for immediate adoption and for continuation until the "Preferred Scheme" can be introduced, the grant of a patent in the United Kingdom carries with it the right to registration in any desired country of the Empire, the act of registration extending the grant to that country. But here, again, before the registration is made, it is open to opposition, if opposition to local grants is permitted by the local law.

Manifestly, whatever scheme came to be adopted by the separate legislatures or law-making bodies, much mutual adjustment of substantive and adjective law would be required. Some of these necessary adjustments were discussed at the conference, and suggestions emanating therefrom appear in the report. None appears to be of such a character as to be outside the bounds of practicability. But to review those subjects which call for adjustment, and to discuss the opinions on these and other points expressed at the conference, would require for each a monograph. From the report it is clear that an extremely small portion of the necessary amendments which the respective authorities would be called upon to make could have been discussed, bearing in mind that the conference held ten meetings only, and that it refused to admit oral evidence from outside, deciding that "no useful purpose would be served by hearing such evidence." There was, therefore, excluded from consideration the oral evidence that could have been given, for example, by the Chartered Institute of Patent Agents, a body which is continually in touch with the needs of inventors and conversant with the working and details of the various patent laws. Of necessity must the conference be looked upon as merely preliminary to attacking at close quarters the problem which it set out to solve.

On the unanimous selection of a scheme by each of the governing authorities, the next step will be for each to submit for general consideration the law, rules, and regulations which must be formulated in order that the selected scheme may be successfully put into operation. Moreover, it will be necessary to distinguish between the law to be applied when the patent is granted and the procedure for obtaining the patent. It will also be found that, in endeavouring to secure a basis for action, the task will be the easier by reason of the large majority of the patent laws of the Dominions having copied the law of the United Kingdom, and of the ultimate Court of Appeal for the Empire being the Judicial Committee of the Privy Council.

In the preparation of a scheme for general adoption it is to be hoped that the authorities will not continue to ignore oral evidence from outside bodies; to do so will be to court failure. Procedure for obtaining a patent and the law and rules relating to patents are so intricate that none but those who are in daily contact with such matters and have learned in the hard school of experience the needs of inventors on one hand and the reasonable requirements of the public on the other, can be expected to produce a scheme which, satisfactory to all parties, can be put into operation without friction, much change in procedure, or extensive amendment of existing laws.

There is no reason to suppose that, if all parties are determined to produce an Empire Patent, the adjustment of conflicting opinions cannot be made nor suitable machinery devised. The result undoubtedly would be to the advantage of all inhabitants of the Homeland and of His Majesty's Dominions beyond the Seas, whether as inventors, manufacturers, or users. It remains, therefore, for the public to urge expedition upon the authorities, or it will be met with the charge of apathy, a plea which so often saves the situation where officials are concerned.

A word or two is to be said in respect of the charge for a copy of the report. In pre-war days, each copy of this small octavo would have been sold for 3*d*. or 4*d*., and the edition promptly exhausted with a consequent wide-spread dissemination of its information. For each copy of this edition of five hundred, however, one shilling is required, a charge which scarcely makes for extensive circulation. The wider the public that the report reaches, the greater chance of a definite outcome of its suggestions, while, at the same time, by the lowering of the price the probability of the recovery of the cost of the edition would not be appreciably lessened.

Industrial Physics.

A Dictionary of Applied Physics. Edited by Sir Richard Glazebrook. (In 5 volumes.) Vol. 1: Mechanics, Engineering, Heat. Pp. ix + 1067. (London: Macmillan and Co., Ltd., 1922.) 3*l*. 3*s*. net.

IN years to come the publication of this monumental work will rank as one of the milestones in British applied science. If argument were needed, none more convincing could be adduced in illustration of the necessity for a working co-operation between the physicist and the engineer. Sir Alfred Ewing recently defined engineering as "the turning to man's use and convenience of the things which it is the business of physics to understand." This Dictionary helps one to realise, as perhaps never previously, that in all branches of engineering the engineer, whether revealing or directing, whether inventing or designing, whether testing or measuring, whether systematising, co-ordinating, or clarifying, is continually turning physical principles to account.

Sir Richard Glazebrook, not content with the enduring monument to his fame in the shape of the National Physical Laboratory, has now laid physicists and engineers under perpetual obligation by undertaking the editorship of this "Dictionary of Applied Physics." No other British man of science, it is safe to say, could have brought the same wide experience, intimate knowledge, and critical judgment to bear upon the production of an encyclopædic work of this nature. For twenty years Sir Richard Glazebrook directed the policy of the N.P.L., and during that period, when the attitude of the nation towards scientific investigation was very different from what it is to-day, he toiled unceasingly to foster the applications of science to industry. To take one example alone, the fact that this country in 1914 led the world in aeronautical research is due in no small measure to his foresight and skilful guidance during the preceding eight years. Sir Richard's breadth of interests and his habit of establishing and preserving personal contact with original investigators are reflected in his choice of collaborators in the preparation of this Dictionary.

The work under review is the first of a series of five volumes, planned to cover the entire range of physics and, in particular, the applications of physics to industry. Volume 1 contains some fifty articles, covering mechanics, engineering, and heat.

Three main facts emerge from a survey of the work before us—first, the unexampled wealth of material; secondly, the authoritativeness, the maturity of judgment, the originality and inviting freshness of treatment which are exhibited by the majority of the writers; and, lastly, the presumption and futility of any single reviewer attempting to appraise such a diversity of articles by such a galaxy of experts. A glance at the names of contributors furnishes sufficient guarantee that the various subjects are dealt with by accepted authorities and experienced investigators; and probably the only useful service that a reviewer can hope to perform is to point out a few of the sins of omission which are inevitable in a treatise planned on such a comprehensive scale.

The first article in the volume is on air pumps, by the staff of the General Electric Co., and deals with the fundamental principles of the various types of pumps employed for evacuation and compression.

Calorimetric measurements are dealt with in a series of five articles by Dr. Ezer Griffiths. The subject is divided into sections dealing with bomb calorimetry, electrical methods of calorimetry, method of mixtures, methods based on change of state and the applications of the quantum theory to specific heat data. A glance through these articles shows how different are the methods employed by research workers from those described in text-books on this subject. As an indication of the highly developed state of technical calorimetry, it might be mentioned that with one of the bomb-calorimeter equipments described—that of the U.S. Bureau of Mines—a skilled operator can average thirty-five determinations per day of the calorific value of fuels. The purely scientific aspect of the subject is not neglected, for we find concise descriptions of the researches of White on specific heats at high temperatures and those of Dewar at low temperatures. Electrical methods of calorimetry naturally occupy a prominent place, for the ease with which electrical energy can be measured and controlled has placed a powerful tool in the hands of workers concerned with thermal measurements.

The principles of dynamical similarity are discussed in an article by Dr. H. Levy. The results of wind-channel and ship-tank experiments on models can be applied to full-scale machines by the use of the Principle of Similitude, which also finds application in numerous other branches of engineering. One is reminded of a famous article by the late Lord Rayleigh in NATURE, vol. 95, p. 66, 1915, in which the full generality and beauty of the Principle of Similitude are brought out. In the space of a column or two Rayleigh deduced a series of fundamental conclusions with the lucidity and brevity which distinguish all his writings.

Four articles are devoted to various aspects of steam engineering. Sir Alfred Ewing contributes one on the theory of the steam engine; Mr. A. Cruickshank another on the reciprocating steam engine, while the importance of the steam turbine fully merits the 38 pages devoted to the two articles on the physics of the steam turbine by Dr. Gerald Stoney and Mr. Telford Petrie, and the development of the steam turbine by Mr. R. Dowson of Messrs. Parsons.

These articles cover the ground pretty thoroughly, so far as present-day practice goes, but one would have liked to know something of the writers' views on the future trend of their subjects. For example, nothing is said of the possibilities of the gas turbine, should the practical difficulties connected with it be overcome, or of the advantages and disadvantages of the steam turbine for aircraft propulsion and on locomotives.

The internal combustion engine is dealt with in three articles: Mr. Aubrey Evans writes on the water-cooled petrol engine; Sir Dugald Clerk and Mr. G. A. Burls on the thermodynamics of internal combustion engines and also on some typical internal combustion engines. The standard work of these authors on the subject is familiar to most students.

On general engineering subjects we note, among many others, a brief monograph by Prof. W. E. Dalby on the balancing of engines and prime movers. In an article on the strength of structures by Mr. J. W. Landon, it is curious that no mention is made of airship and aeroplane structures, which are certainly of considerable interest at the present time.

Dr. T. E. Stanton's article on friction, supplemented by a very brief one by Mr. W. B. Hardy on boundary conditions in lubrication, form a complete and masterly résumé of this fascinating subject, in which there have been considerable developments during the past few years.

Elasticity has two articles devoted to it, one on the theory of elasticity by Mr. R. V. Southwell, and the other on elastic constants by Mr. R. G. Batson. Mr. Southwell's article of 11 pages is as brief as Mr. Batson's article of 125 pages is long. One would have liked to see included in the former a brief account of the mathematical researches which find practical application, such as the effect of keyways on the strength of a shaft, the vibration of rotating masses, such as turbine discs, the torsional vibration of propeller shafts, etc. Mr. Batson's article, which is lavishly illustrated, deals primarily with the testing of the materials of construction. We note that Fig. 120, p. 196, has evidently been transferred direct from a catalogue without the superfluous lettering being removed. In view of the thorough treatment of the subject of thermoelectric pyrometry in this volume, there was doubtful justification for including an elementary account of the principle of thermoelectric pyrometers in an article devoted to elasticity. Moreover, the sections on the permeability of concrete, together with those on attrition and abrasion tests, are somewhat uncomfortably housed in an article on elastic constants. The question of the seasoning and testing of timber merits a more exhaustive treatment than is accorded to it here.

Space does not permit of a review of the numerous short articles on various aspects of engineering, but some of the omissions may be pointed out for future rectification. In the brief article on gyroscopes by Dr. G. T. Bennett, no mention is made of important practical applications, such as gyro-compasses, stabilisers, and aeroplane-level indicators. The article on dynamometers, by Mr. J. H. Hyde, is confined mainly to the more familiar types. One would have liked, for example, to know something of those developed for testing aircraft engines during flight.

Mr. F. H. Schofield contributes articles on heat conduction and convection, the recent work of the Heat Department of the National Physical Laboratory on these subjects being well summarised. The classical researches on the mechanical equivalent of heat are ably reviewed by Dr. E. H. Griffiths. Reading his account of the difficulties encountered by early workers makes us realise how much they did indirectly to advance progress by following up the discrepancies between various temperature scales on one hand and the several electrical standards on the other. Sir Alfred Ewing contributes articles on thermodynamics, the liquefaction of gases and refrigeration, which are models of charm and clarity. The article on liquefaction might well have been amplified to include the advances of the last few years.

Temperature measurements are covered in a series of six articles. Messrs. Day and Sosman of the Geophysical Institute, U.S.A., are authors of an article on the realisation of the absolute scale of temperature. In this most readable contribution will be found a critical review of the numerous researches on the gas thermometer throughout the past century, which have helped to lay the basis of the standard scale of temperature in use at the present day.

Dr. Ezer Griffiths contributes noteworthy articles on resistance thermometers, thermocouples, total radiation pyrometry, and optical pyrometry. The resistance thermometer holds a unique position in practical pyrometry. Too fragile for works' use, as originally intended by Siemens, it has developed into a precision laboratory instrument. The practical scale of temperature over the range $-40°$ C. to $+1100°$ C. can be reproduced with extraordinary accuracy by the aid of a platinum resistance thermometer calibrated at the ice, steam, and sulphur points. Detailed descriptions of the methods to be employed in calibration and the precautions which must be observed will be found in the article.

As modern methods of measuring temperature have developed chiefly in the direction of electrical appliances, one naturally finds that prominence is given to a discussion of various types of potentiometers in the article on thermocouples. Considerable advance has been made in recent years in the design of thermoelectric potentiometers, and the student of purely electrical measurements might also with advantage study this section.

A notable feature of the article on optical pyrometers is the discussion of the theory underlying the use of red glass for obtaining approximately monochromatic light. This is a factor of fundamental importance when temperatures of the order of 3000° C. have to be measured by means of pyrometers calibrated on the basis of Wien's law to represent the distribution of energy in the spectrum of a "full radiator." The "disappearing filament" type of pyrometer has been greatly developed in recent years at the N.P.L. and elsewhere, and it would appear that, in time, it will supplant most of the other types now in use for high-temperature measurements.

Thermometry is covered by a comprehensive article written by Mr. W. F. Higgins. A detailed account is given of the N.P.L. equipment for thermometer testing, together with a complete discussion of the mercurial thermometer. No consideration is given to vapour-pressure thermometers. During the war many thousands per week were made for use on aircraft, and they are also being extensively fitted to motor-car radiators at the present time. Doubtless the new mercury-in-steel transmitting thermometers, which have been successfully developed and are coming into wide use, will receive a longer notice in a future edition.

Mr. G. S. Baker writes on ship resistance, Prof. Horace Lamb contributes mathematical articles on Fourier's series, etc., Dr. A. W. Porter treats of thermal conductivity, and Mr. Jakeman deals with the measurement of pressure.

We regret that we have not space to notice the numerous short articles scattered throughout the volume, some of which are intended to supplement the longer articles.

There is an excellent name-index. The references are plentiful, and appear to have been carefully checked. The only slip which we have noticed is on page 1025, the Physical Society modestly confining itself to Proceedings, not Transactions, as implied by the writer. We notice that the names of Mr. Whetham (Phase Rule) and Miss Austin (Units of Measurement) have been omitted from the list of contributors on p. vii.

The printers have done their work well, and the publishers are to be congratulated on their enterprise and the general "turn-out" of the book. It was inevitable that a book of 1000 or more pages of this type should be expensive. The pity of it is that the price will put it out of the reach of so many students. It is true that they may have recourse to the nearest library, but the book is such that one would like to see every senior student of the subject with his own copy. Some of the articles will be a revelation to him, bearing as they do little resemblance in substance and treatment to the majority of the present-day text-books. The division of the Dictionary into volumes on a subject-basis, and the fact that individual volumes are purchasable, are features greatly to be commended. Perhaps in the future it may prove possible to extend the system and divide the Dictionary into, say, double the number of smaller volumes, each confined to one main branch of the subject, and proportionately less costly. The volumes would be lighter to handle, and the formidable task of keeping so large a work abreast of modern science would be much facilitated.

G. W. C. KAYE.

Position of Agriculture in India.

Agricultural Progress in Western India. By G. Keatinge. Pp. xii+253. (London: Longmans, Green and Co., 1921.) 6*s.* net.

AGRICULTURAL conditions in India are such that any estimate of progress must be largely indirect. The bulk of the land is farmed in small holdings by peasants who keep no accounts, and sell their surplus products in local markets which render no statistical returns; again, the value of export crops, such as cotton, is subject to wide fluctuations owing to the erratic rainfall. But, by a consideration of other factors, such as the area under cultivation, changes in land values and rentals, irrigation schemes, and the standard of living, there is definite evidence of progress. Mr. Keatinge has spent thirty years in the midst of agricultural problems in the Bombay Presidency, and in this very interesting book he sets out his estimate of the progress that has been made, the obstacles to further advancement, and a proposed future policy.

With regard to the obstacles in the way of further advancement, the most serious one is the Hindu law of inheritance, by which each male member of a family is entitled to an equal share of the family property. This results, not only in the division of farms into uneconomic units, but in a further subdivision into scattered plots—a process reminiscent of the old three-field system in England. Another fundamental difficulty is that cattle cannot be bred and kept solely for profit, owing to their significance in the Hindu religion. They are of inefficient types, used of necessity in an uneconomic manner, and are more of a hindrance than a help to the struggling farmer. As an illustration of the difficulty of introducing improvements which do not clash seriously with the social and religious habits of the cultivators, the author considers the use of irrigation water. It appears that, financially, most irrigation canals are unsuccessful owing to the slow manner in which these facilities are